The Role of Mulsemia in Digital Content Ecosystem Design

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ABSTRACT
Digital ecosystem is a self-organizing infrastructure for creating digital environment. Similar to natural ecosystems, several digital ecosystems exist. This is due to differentiation and the development of native products and services tailored to specific local needs. Digital content is the core component of any digital ecosystem. As of now, most of the digital content focuses on only two senses. This paper highlights the significance of other senses which are to be incorporated in the creation of digital content to be used in the digital ecosystems.

Categories and Subject Descriptors
E.2 [Data Storage Representations]: Multimedia, Mulsemia

General Terms
Human Factors, Standardization, Design, Management

Keywords
Multimedia, Mulsemia, Web 2.0, Real Virtuality, Virtual Reality, eLearning, eHealth

1. INTRODUCTION
In the broadest sense, digital content refers to any information that is published or distributed in a digital form, including text, data, sound recordings, photographs and images, motion pictures, and software. Digital contents are created, captured, stored or delivered in a digital format. In fact, content in analog form may get transformed to digital form at some instance [1]. Digital content is prevalent in almost every market sector such as Entertainment, Marketing and Advertising, Corporate, Academic and Government and Organizations.

1.1 Entertainment
Multimedia entertainment applications involving digital content aim at providing amazing experiences such as reading a book, hearing music, viewing videos, and playing games [2]. The advances in ICT promote the entertainment applications from a passive world to interactive world such as virtual reality, interactive storytelling and online games. Wide range of people from children to elderly, abled to disabled, academic to industry can acquire immersive experiences through these applications.

1.2 Marketing and Advertising
Marketing and advertising are the ways of promoting products and services. These products and services are delivered to consumers in a timely, relevant, personal and cost-effective manner through digital channels such as TV, internet and mobile devices. Various digital content involved in this scenario are web pages, blog content, email, SMS, RSS etc.

1.3 Corporate
Corporate deal with enormous amount of digital content about customers, products, employees, materials, suppliers, metadata, software, applications, and business processes and enable communications and interactions among the stakeholders.

1.4 Academic
Institutions, Universities and Research Labs deal with plenty of digital content in the form of courseware, presentations, video lectures, multimedia animations for class room based learning, e-Learning, web based learning, mobile learning and virtual learning.

1.5 Government
Various stakeholders in a government such as citizens, government, inter-agencies and business enterprises interplay involving digital content in the forms of reports, studies, bills, press releases, forms, and statistics. Documents in HTML, Text, PDF forms and Spreadsheets play vital role in government transactions and communications.

Digital content brings together all the entities of Entertainment, Marketing and Advertising, Corporate, Academic and Government and Organizations into an environment to form an Ecosystem (Figure 1)
The rest of the paper is organized as follows. Section 2 introduces the notion of ecosystem. The concepts of digital ecosystem and digital content ecosystem are explained in section 3 and section 4. While section 5 illustrates the road ahead of multimedia, section 6 gives a summary of multimedia for ecosystem design.

2. ECOSYSTEM

An ecosystem is a loosely coupled, domain clustered environment inhabited by species, each proactive and responsive regarding its own benefit while conserving the environment [3]. Ecosystem consists of two major elements namely Species and the environment where both of them are intertwined. Species interact with each other and balance each other, even though some species may play a leading role at times. The environment supports the requirements of the species which is continued generation after generation.

Organizations, like organisms, are built in complex hierarchies. One is made up of cells within tissues within organs, within organisms within populations, while the other is comprised of work teams inside departments inside divisions inside business inside industries [3].

Moore [4] introduced the term “business ecosystem” that can span a variety of industries. The companies within them co-evolve capabilities around innovation and work cooperatively and competitively to support new products, satisfy customer needs and incorporate the next round of innovation.

3. DIGITAL ECOSYSTEM

Digital ecosystem is a kind of ecosystem where environment is digital and populated by digital species [5]. These digital species can be software components, applications, online services, training modules, contractual frameworks, laws, information and business models and social networks. Digital species can be processed by computers or humans.

Digital ecosystem infrastructure includes mechanisms for the composition, the evolution and the migration of the digital components among the different habitats.

Like ecosystems, digital ecosystems may also have several sub-ecosystems. Each sub-ecosystem has its own services and solutions and can interact with the environment. In general, every ecosystem can use the services of the common environment.

4. DIGITAL CONTENT ECOSYSTEM

Digital Ecosystem focuses on processes and infrastructure of a sectoral ecosystem. In all the activities related to Digital Ecosystem, the digital content plays a major role. Whether it is an office document, learning object for e-learning courseware, a video clip for an advertisement, a business form, or movie trailer, all are some or other form of digital content. The digital ecosystem is completely revolutionized with the seamless availability and flow of digital content with the focus on defining a new ecosystem namely Digital Content Ecosystem (DCE) in which the focus is on the digital content.

Based on the business activities where the digital content has to be produced, reused, extended and managed by the inhabitants, there exist various types of Digital Content Ecosystems. Types of Digital Content Ecosystem are Digital Entertainment Ecosystem (DEE), Digital Marketing & Advertising Ecosystem (DMAE), Digital Corporate Ecosystem (DCE), Digital Academic Ecosystem (DAE), Digital Government and Organizations Ecosystem (DGOE) (see Figure2).

5. THE ROAD AHEAD

One of the challenges of the creators of ecosystem is to pay attention to the design aspects of digital content. While designing, the designers must address the following issues.

a. There is a need to explore new dimensions of digital content to cater to the needs of different types of users as well as business activities. Whether the digital content is a representative for all types of users?

b. The digital content used in the ecosystems considers only two senses namely visual and auditory aspects of multimedia content. Whether these two senses alone are sufficient for digital content representation? Can we leverage the availability of other senses – touch, smell and taste?

Let us consider certain scenarios that highlight the importance of other senses to be made available in digital content creation and usage. There exist certain issues and challenges in using the digital content as such in the ecosystem. The environment may have varied types of people such as physically-abled, disabled, elderly and so on.

5.1 Packaging Industry

To introduce better products to meet the competitive edge in the market and also to provide better features for the purchaser to choose the one from many, it becomes essential for the designers to introduce new aspects in packaging. According to brand
futurist Martin Lindstrom, purchasing decisions are highly influenced by multiple senses as shown in Table 1.

<table>
<thead>
<tr>
<th>Sense</th>
<th>Impact</th>
<th>Buying decisions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Smell</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Sound</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Touch</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Ecosystem designer must give importance to incorporate the sensory aspects in the digital content design which are made available through e-commerce or web applications [6].

5.2 Health Care Systems
Whenever the physicians need to analyze the physical conditions of patients based on sensory data through networked or web enabled environment, the ecosystem should have means to represent the multiple sensory data. Consider an e-Health service has to accurately and timely monitor disabled people. Here, disabled refers to elderly and/or person with several physical disabilities. In this scenario, the context related to the environment, event data and sensory data together form the digital content.

5.3 Learning Models
Recently universities, institutions (public or private) and research organizations adopt different types of learning models – e-Learning, Web Based Learning, Multimedia Learning, Mobile Learning etc. Learning objects constitute the major component in defining the courseware in all these models. Learning object is a resource, usually digital and web-based content that can be used and re-used to support learning [7]. Learning objects are smaller, self-contained and re-usable units of learning.

Mostly learning objects are created for auditory and visual senses only. For the learners to exploit the other dimensions of learning experiences, it is mandatory for the digital content ecosystem designers to incorporate other senses – haptic, olfactory and tactile in the learning objects. We call this kind of digital content ecosystem as Mulsemedia ecosystem. As shown in figure 3, the stakeholders of mulsemedia ecosystem interplay with each other and have to deal with data from multiple sensory devices.

6. CONCLUSION
Digital ecosystems are interwoven around people and content. In this context, the content available in digital ecosystems must be created giving importance to the varied types of people involved in it. To improve the business activities to its fullest extent and to define flexibility in data perception, the digital content must also include mulsemedia features.